

CLAIMS

1. A lapping machine comprising:
 - a lapping surface plate rotated by a rotating mechanism;
 - a lapping jig having a plurality of projections to bottom surfaces of which a work to be lapped by a lapping surface on the lapping surface plate is fitted;
 - variation-of-projection adjusting elements for adjusting the variation of the plurality of projections to the lapping surface plate individually; and
 - a control circuit for outputting variation-of-projection control signals to the variation-of-projection adjusting elements.
2. A lapping machine according to claim 1, wherein the variation-of-projection adjusting elements are heating elements for heating the projections respectively.
3. A lapping machine according to claim 1, wherein the variation-of-projection adjusting elements have actuators for deforming the projections respectively.
4. A lapping machine according to claim 1, wherein a plurality of resistive elements which are lapped by the lapping surface of the lapping surface plate are fitted to the work, and
 - the control circuit has a function for measuring resistance values of the plurality of resistive elements.
5. A lapping method comprising the steps of:
 - fitting a bar-like work, which is lapped by a lapping surface of the lapping surface plate, to bottom surfaces of a plurality of projections of a lapping jig;
 - adjusting a variation of the projections by variation-of-projection adjusting elements individually; and
 - lapping the work by the lapping surface.
6. A lapping method according to claim 5, wherein the work is separated between the projections before lapping of the work.

7. A lapping method according to claim 5, wherein resistive elements arranged on the projections respectively are formed on the work, and

resistance values of a plurality of resistive elements are measured, and then the variation of the projections is increased as a resistance value is smaller.

8. A manufacturing method of magnetic head comprising:

a step of forming a bar-like work on which a plurality of magnetic heads are aligned;

a step of fitting the work to bottom surfaces of a plurality of projections of a lapping jig such that the magnetic heads are overlapped with the projections respectively;

a step of adjusting a variation of the plurality of projections by a plurality of variation-of-projection adjusting elements individually; and

a step of lapping the magnetic heads, whose top end positions are adjusted by adjusting the variation of the projections on the work, by a lapping surface of the lapping surface plate.

9. A forming method of magnetic head according to claim 8, wherein the work is divided into plural pieces between the projections before adjustment of the variation of the projections.

10. A forming method of magnetic head according to claim 8, wherein the variation-of-projection adjusting elements consist of heating elements.

11. A forming method of magnetic head according to claim 8, wherein the variation-of-projection adjusting elements have actuators that deform the projections.

12. A lapping method according to claim 8, wherein a plurality of resistive elements that are arranged on the plurality of projections individually are formed on the work, and

resistance values of the plurality of resistive elements are measured respectively, and then the variation

of the projections is increased as a resistance value is smaller.

13. A magnetic head manufacturing method according to claim 12, wherein the resistive elements consist of a magneto-resistive effect element.

14. A manufacturing method of magnetic head comprising the steps of:

fitting a bar-like work having a plurality of magnetic heads and a plurality of resistive elements, that are lapped by a lapping surface of a lapping surface plate, to a lower surface of a lapping jig;

connecting a plurality of pushing/pulling mechanisms, that push down and pull up the lapping jig in a vertical direction with respect to the lapping surface, to a plurality of operation points of the lapping jig;

measuring individual reference bending curves of the pushing/pulling mechanisms when a reference pushing/pulling force is applied to the lapping jig while selecting one of the pushing/pulling mechanisms sequentially;

measuring a current shape of a lower surface of the work;

setting a target shape of the work;

calculating a correction shape that is a difference between the current shape and the target shape;

calculating one pushing/pulling curve that is most approximate to the correction shape, by multiplying respective reference bending curves of the plurality of pushing/pulling mechanisms by an optimization ratio individually and then superposing them; and

adjusting heights of the magnetic heads by lapping the work, the magnetic heads, and the resistive elements by virtue of friction between the lapping surface and them, while pushing/pulling the lapping jig to/from the lapping surface by the plurality of pushing/pulling mechanisms by applying pushing/pulling amounts, that are derived by multiplying the plurality of reference bending curves by

the optimization ratio individually, to the plurality of pushing/pulling mechanisms.

15. A manufacturing method of magnetic head according to claim 14, wherein the current shape of the work is an initial shape of the work.

16. A manufacturing method of magnetic head according to claim 14, wherein the optimization ratio that is multiplied to the reference bending curves of the pushing/pulling mechanisms is calculated by using a conditional expression that can minimize a sum of squares of a deviation between a third function, that is derived by superposing a first function representing the current shape and a second function representing the pushing/pulling curves, and a fourth function representing the target shape.

17. A manufacturing method of magnetic head according to claim 14, wherein the target shape is updated in response to a lapping progress situation of the work.

18. A lapping machine comprising:

a lapping surface plate rotated by a rotating mechanism;

a lapping jig to a lower surface of which a work to be lapped by a lapping surface of the lapping surface plate is fitted;

a sliding surface formed in the lapping jig;

a plurality of pushing/pulling elements brought slidably into contact with the sliding surface; and

a plurality of actuators for driving the plurality of pushing/pulling elements vertically with respect to the lapping surface.

19. A lapping machine according to claim 18, wherein the plurality of pushing/pulling elements are arranged in order of larger peak out of a plurality of peak positions that appear on a curve of the current shape of the lower surface of the work.